Extending DSM2 V8.1.2 Historical Simulation to 1962

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CH2M

DSM2 Users' Group Meeting

December 2016

Purpose

- US Fish and Wildlife Service is developing a delta smelt life cycle model (DSLCM).
- In support of DSLCM development, CH2M is assisting USFWS with simulation of:
  - Delta hydrodynamics coinciding with various fish surveys, and
  - particle transport and fate during Mar – Jun months for 1962 – 2015 period

Overview

- CH2M previously extended historical DSM2 simulation to include 1962-2010 with V8.0.6, covering the period of various fish surveys in the Delta
- Converted USFWS work from DSM2 V8.0.6 to V8.1.2 and extended simulation period to include 1962-2016
- Limited verification with historical data (obtained from IEP database) and previous work
- Nearly, 5000 PTM simulations performed for 1962 – 2015 period, and the results stored in an interactive EXCEL database

Model Inputs – Inflows and Diversions

- Used same boundary conditions as previous work
  - Daily boundary inflows were based on DAYFLOW data
  - Daily CVP and SWP exports, NBA and CCWD diversions were based on the DAYFLOW data
  - CCWD diversions from 1962 – Sep 1997 were at the Rock Slough intake
  - BBID and Banks exports prior to May 1971 from Italian Slough at node 209
  - DICU data from DWR
- Curtailed DICU and CCWD diversions during 1977 drought to prevent drying of channels

Model Inputs – Gate Operations

- Clifton Court Forebay gates from May 1971 based on the DWR's gate operations database; closed prior to May 1971
- Operation of Delta Cross Channel gate and South Delta temporary barriers' based on the DWR's gate operations database
- Head of Old River barrier fall operations extended to 1968
- Operations of 1976 – 77 emergency mitigation barriers' and Suisun Marsh Salinity Control Gate incorporated by DWR
- False River in 2015

Model Inputs – Levee Failure Events

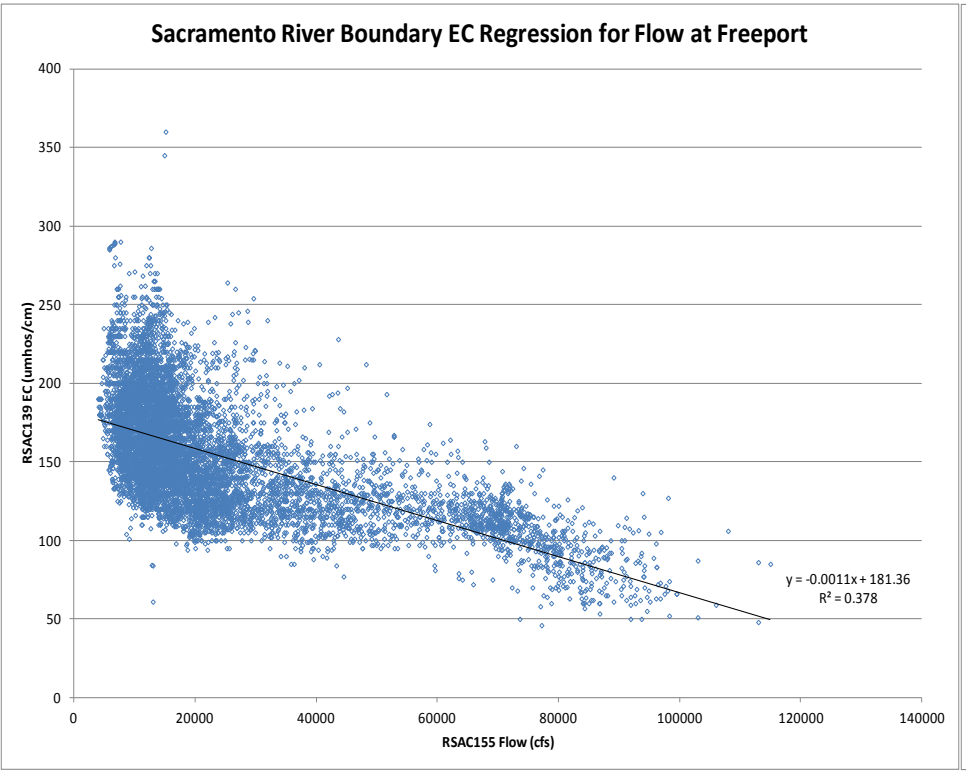
- Cataloged historic levee failures in the Delta based on DRMS, Frank Hopf's dissertation, DWR's Bulletin 69
- DWR modeled 11 events between 1980 – 1986 using time series of breach flows and pump-out flows
- 1962 model extension focused on breach events during Mar – Jun months; only Brannan-Andrus island breach in June 1972 was modeled
- Brannan-Andrus breach event modeled as reservoir-gate constructs in DSM2 based on approach outlined in DWR's 2005 Annual Report
- Pump-outs modeled as object to object transfers

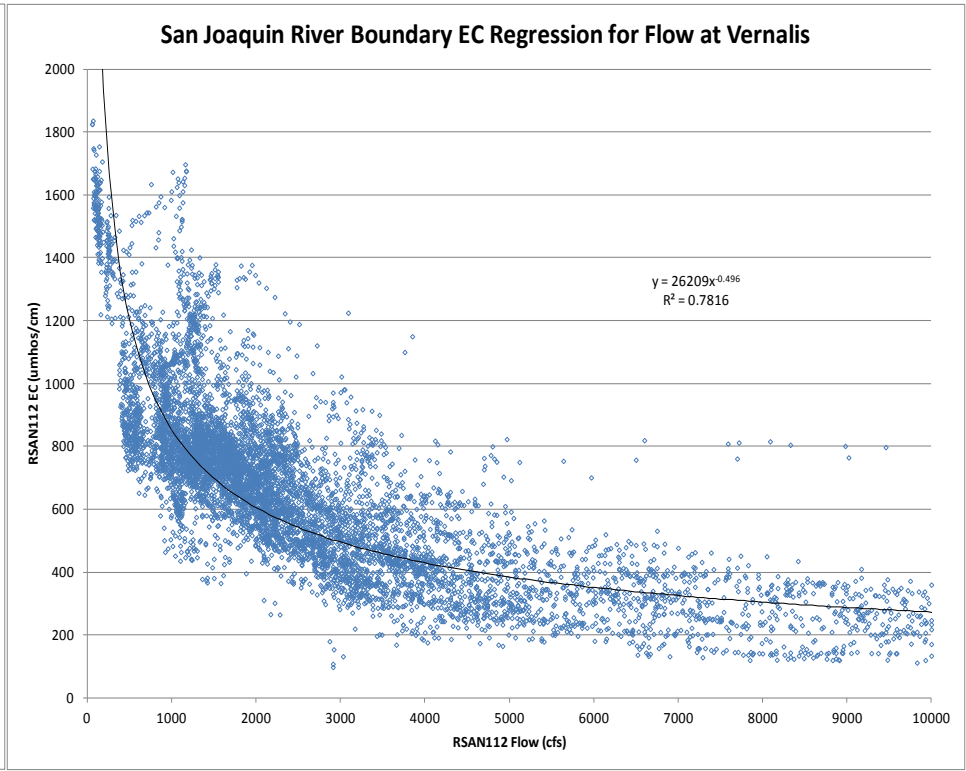
Model Inputs – Martinez Tide and EC

- 82 year adjusted astronomical tide record developed for DSM2 planning simulations was used at Martinez
- EC at Martinez was calculated using the simulated delta outflow from HYDRO, and the g-model used in the DSM2 planning simulations.

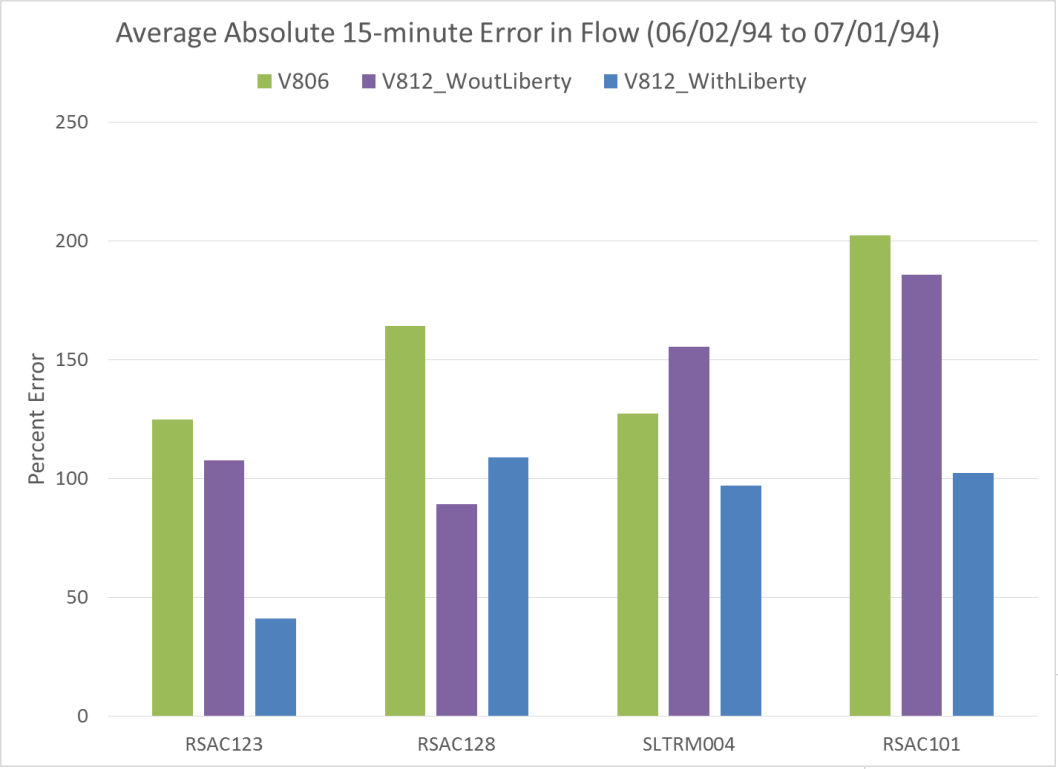
Model Inputs – Sacramento and San Joaquin EC

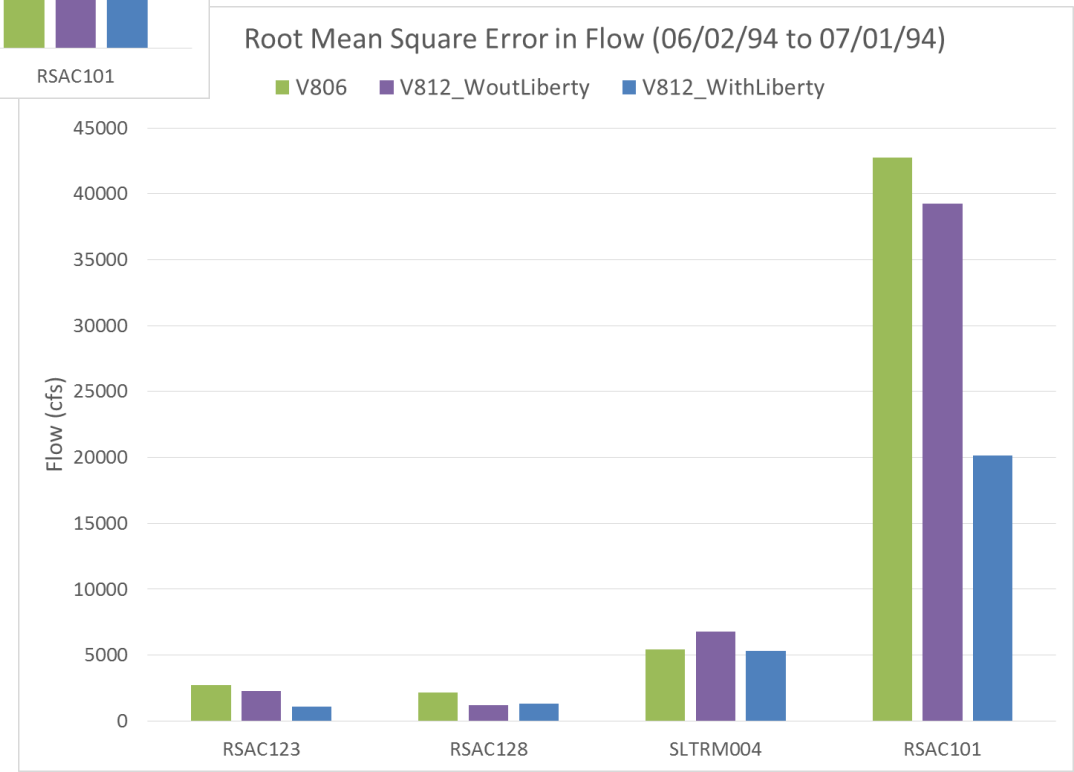
- Sacramento River EC was based on a simple linear regression between Freeport flow and Green's Landing EC
- San Joaquin River EC was based on a power regression between Vernalis flow and EC (capped to 1800 umhos/cm)





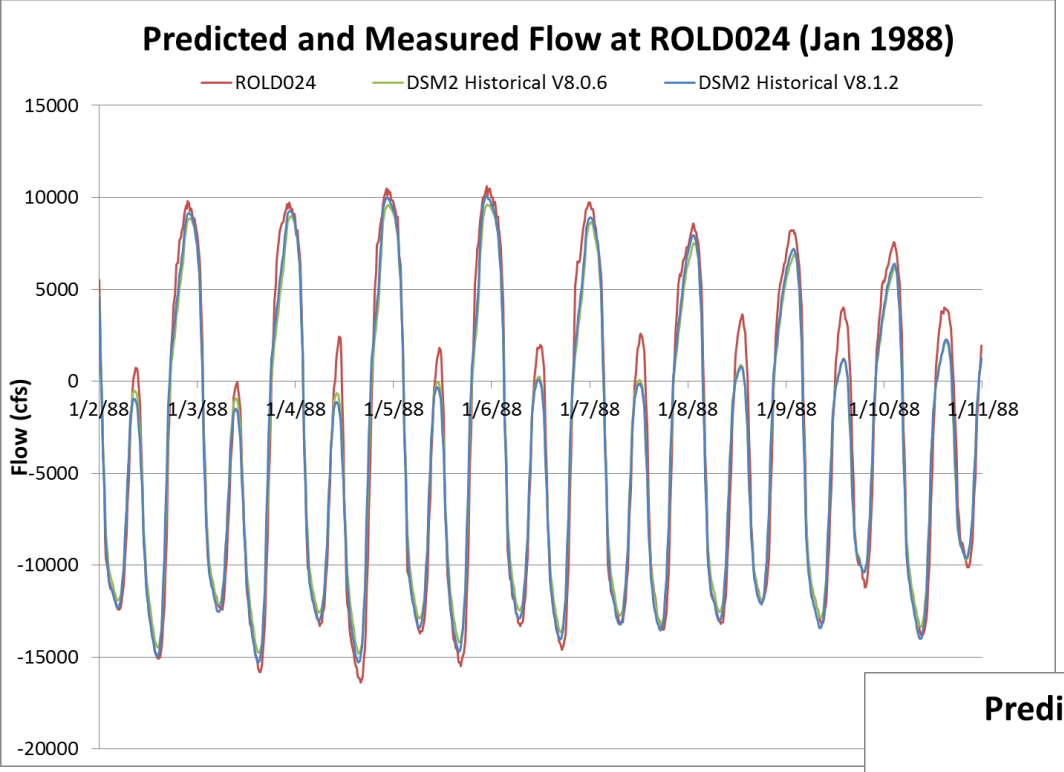
With or Without Liberty Island?

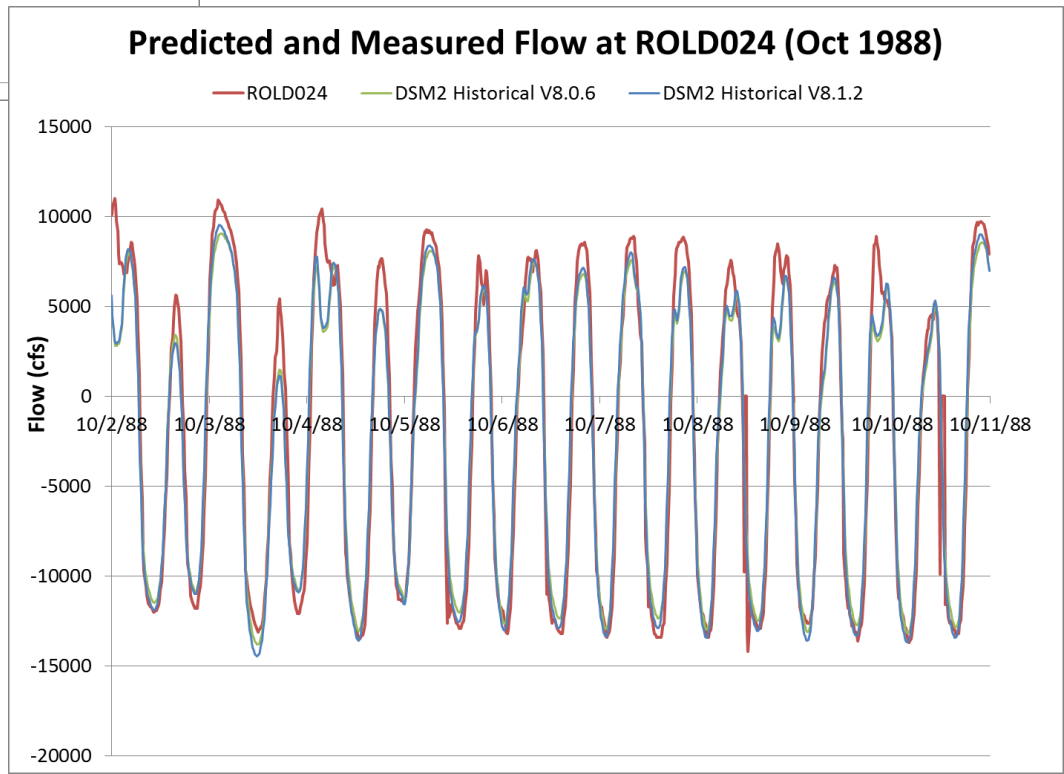

Average Absolute 15-minute Error in Flow (06/02/94 to 07/01/94)
V806
V812_WoutLiberty
V812_WithLiberty
Percent Error
250
200
150
100
50
0
RSAC123
RSAC128
SLTRM004
RSAC101

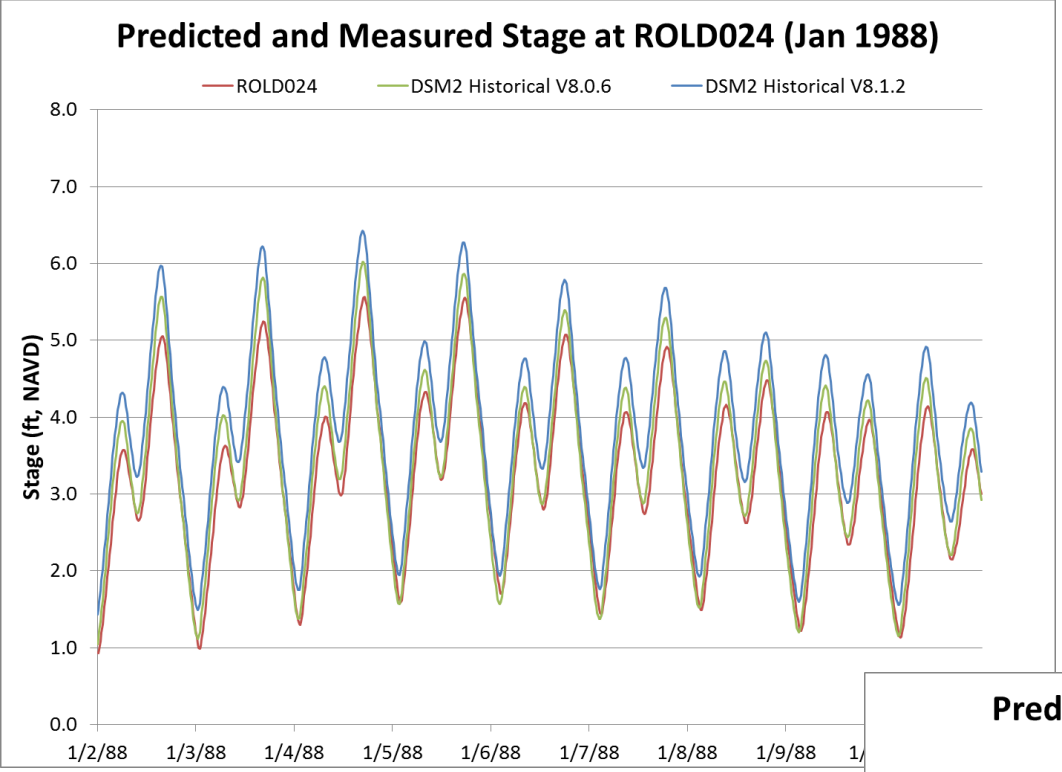

Root Mean Square Error in Flow (06/02/94 to 07/01/94)
V806
V812_WoutLiberty
V812_WithLiberty
Flow (cfs)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
RSAC123
RSAC128
SLTRM004
RSAC101

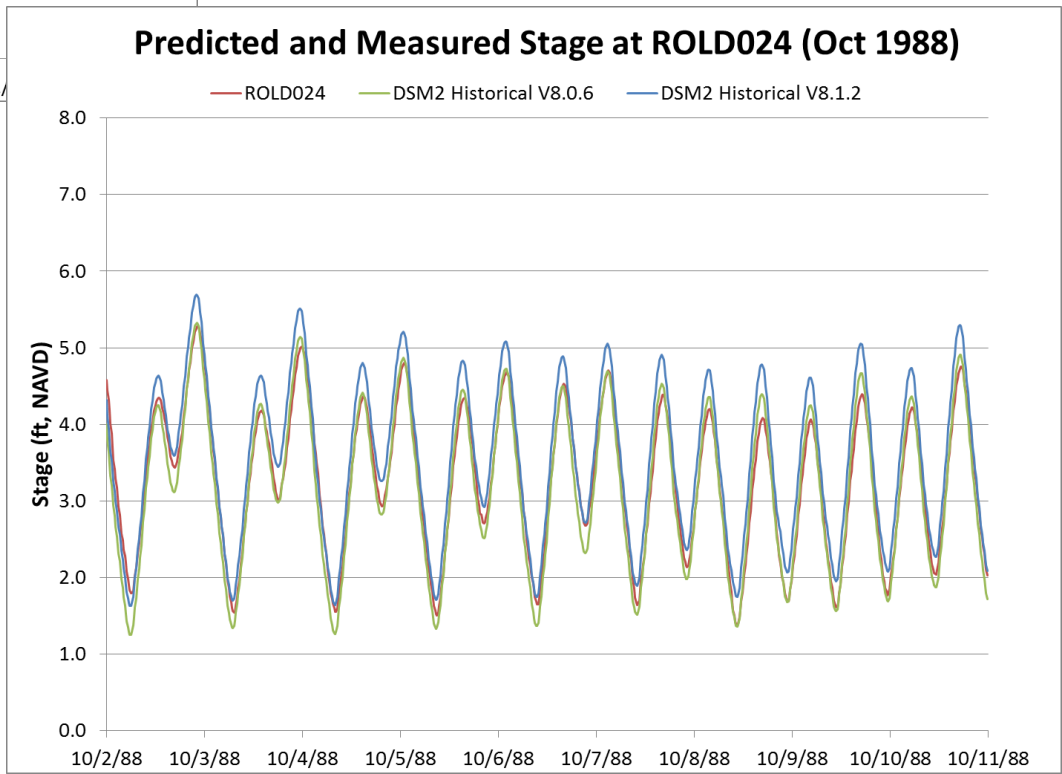
HYDRO Results

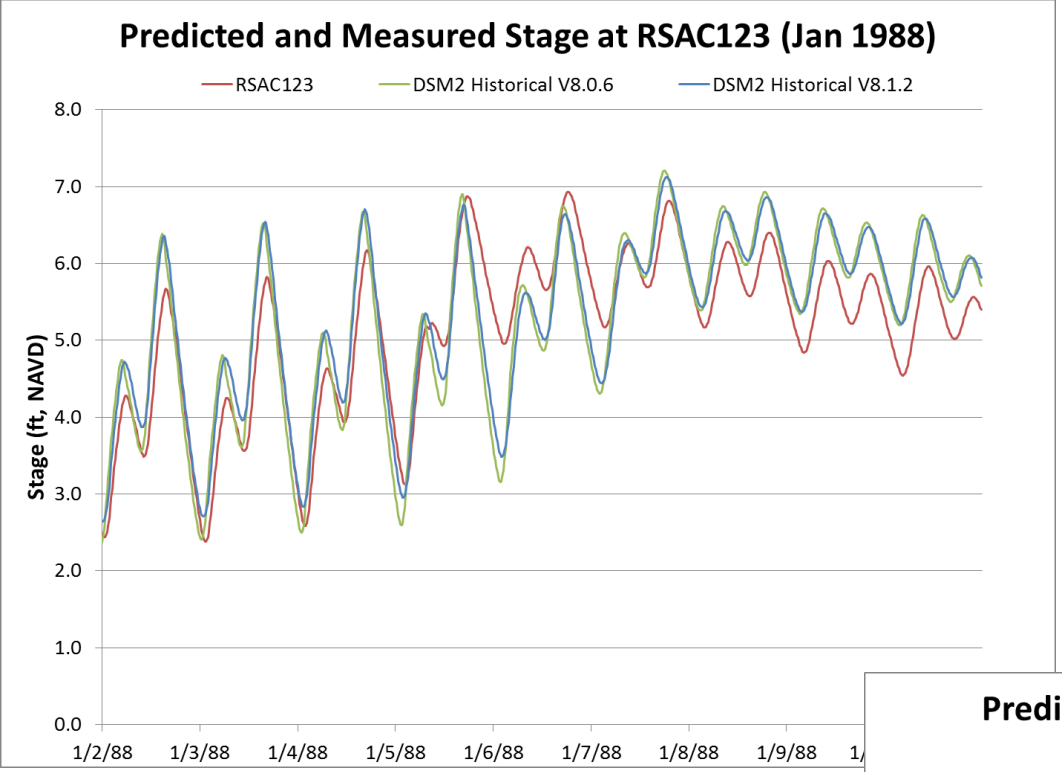
- Limited to time series comparisons for flow/stage at 3 locations during Jan 1988 and Oct 1988:
  - Old River at Bacon Island (ROLD024)
  - Sacramento River near Georgiana Slough (RSAC123)
  - San Joaquin River at Rough and Ready Island (RSAN058)

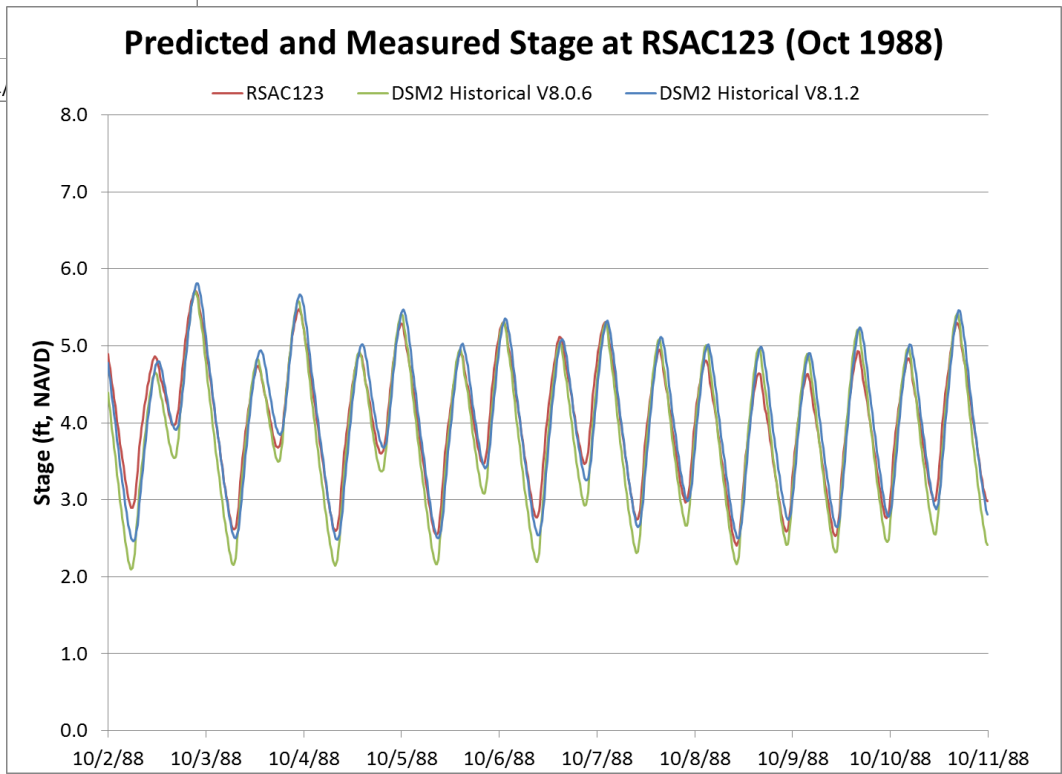

Predicted and Measured Flow at ROLD024 (Jan 1988)
ROLD024
DSM2 Historical V8.0.6
DSM2 Historical V8.1.2
Flow (cfs)
15000
10000
5000
0
-5000
-10000
-15000
-20000
1/2/88
1/3/88
1/4/88
1/5/88
1/6/88
1/7/88
1/8/88
1/9/88
1/10/88
1/11/88

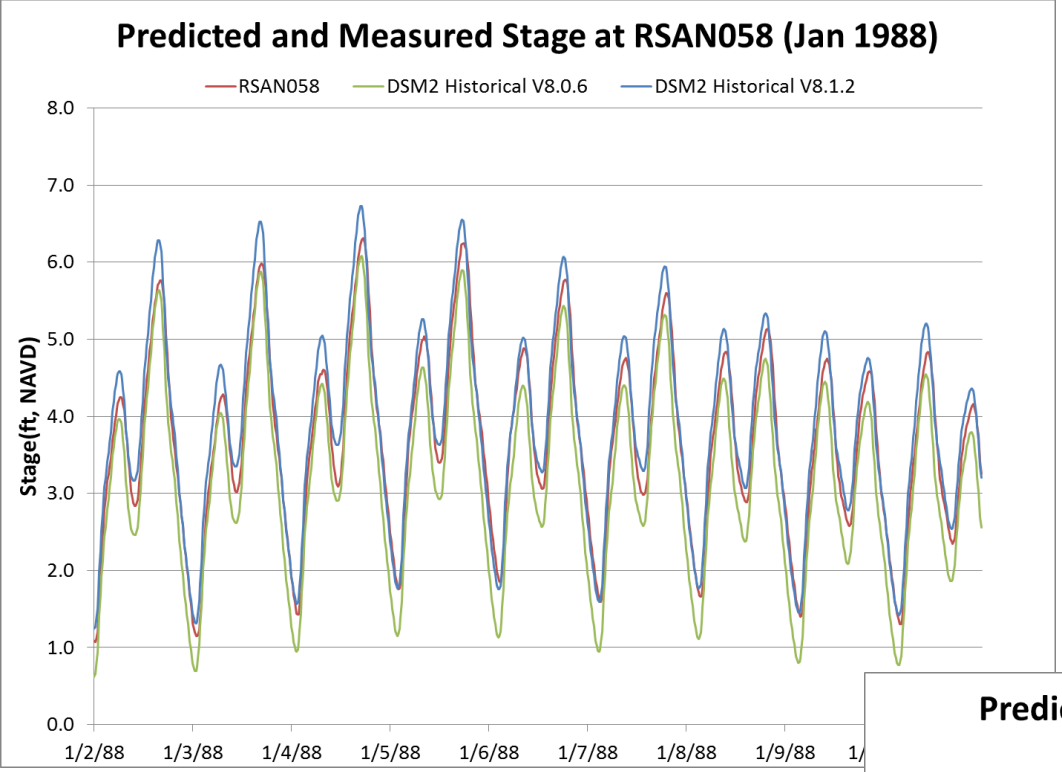

Predicted and Measured Flow at ROLD024 (Oct 1988)
ROLD024
DSM2 Historical V8.0.6
DSM2 Historical V8.1.2
Flow (cfs)
15000
10000
5000
0
-5000
-10000
-15000
-20000
10/2/88
10/3/88
10/4/88
10/5/88
10/6/88
10/7/88
10/8/88
10/9/88
10/10/88
10/11/88

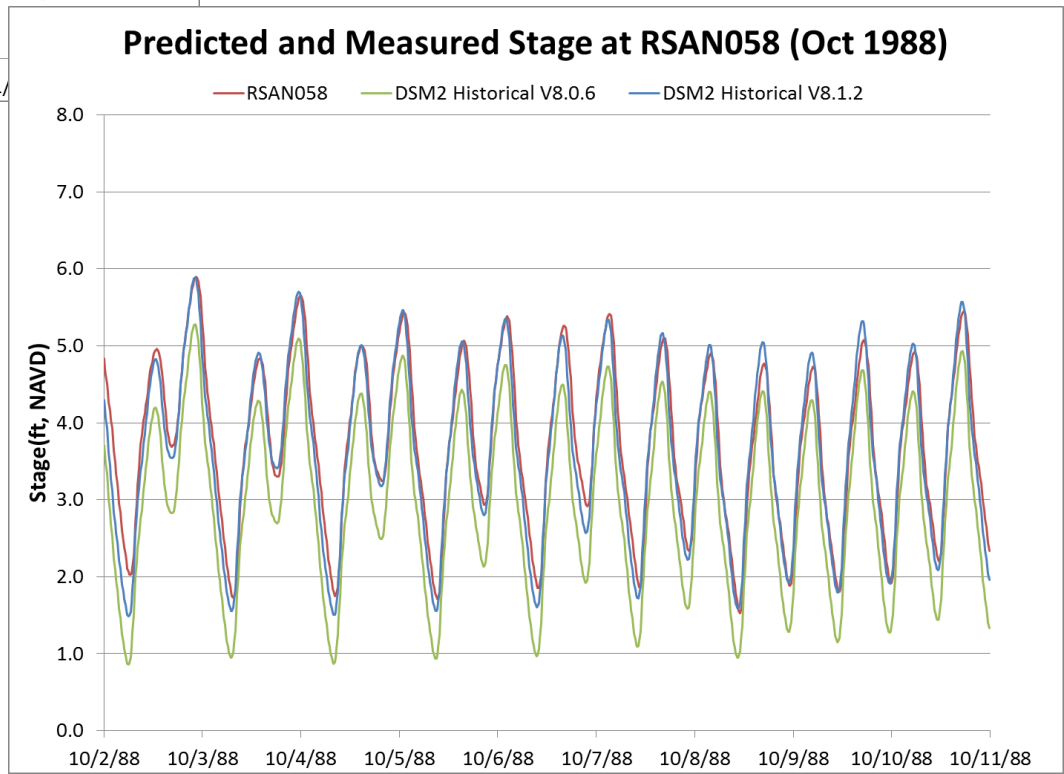

Predicted and Measured Stage at ROLD024 (Jan 1988)
ROLD024
DSM2 Historical V8.0.6
DSM2 Historical V8.1.2
Stage (ft, NAVD)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1/2/88
1/3/88
1/4/88
1/5/88
1/6/88
1/7/88
1/8/88
1/9/88


Predicted and Measured Stage at ROLD024 (Oct 1988)
ROLD024
DSM2 Historical V8.0.6
DSM2 Historical V8.1.2
Stage (ft, NAVD)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
10/2/88
10/3/88
10/4/88
10/5/88
10/6/88
10/7/88
10/8/88
10/9/88
10/10/88
10/11/88


Predicted and Measured Stage at RSAC123 (Jan 1988)
RSAC123
DSM2 Historical V8.0.6
DSM2 Historical V8.1.2
Stage (ft, NAVD)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1/2/88
1/3/88
1/4/88
1/5/88
1/6/88
1/7/88
1/8/88
1/9/88


Predicted and Measured Stage at RSAC123 (Oct 1988)
RSAC123
DSM2 Historical V8.0.6
DSM2 Historical V8.1.2
Stage (ft, NAVD)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
10/2/88
10/3/88
10/4/88
10/5/88
10/6/88
10/7/88
10/8/88
10/9/88
10/10/88
10/11/88

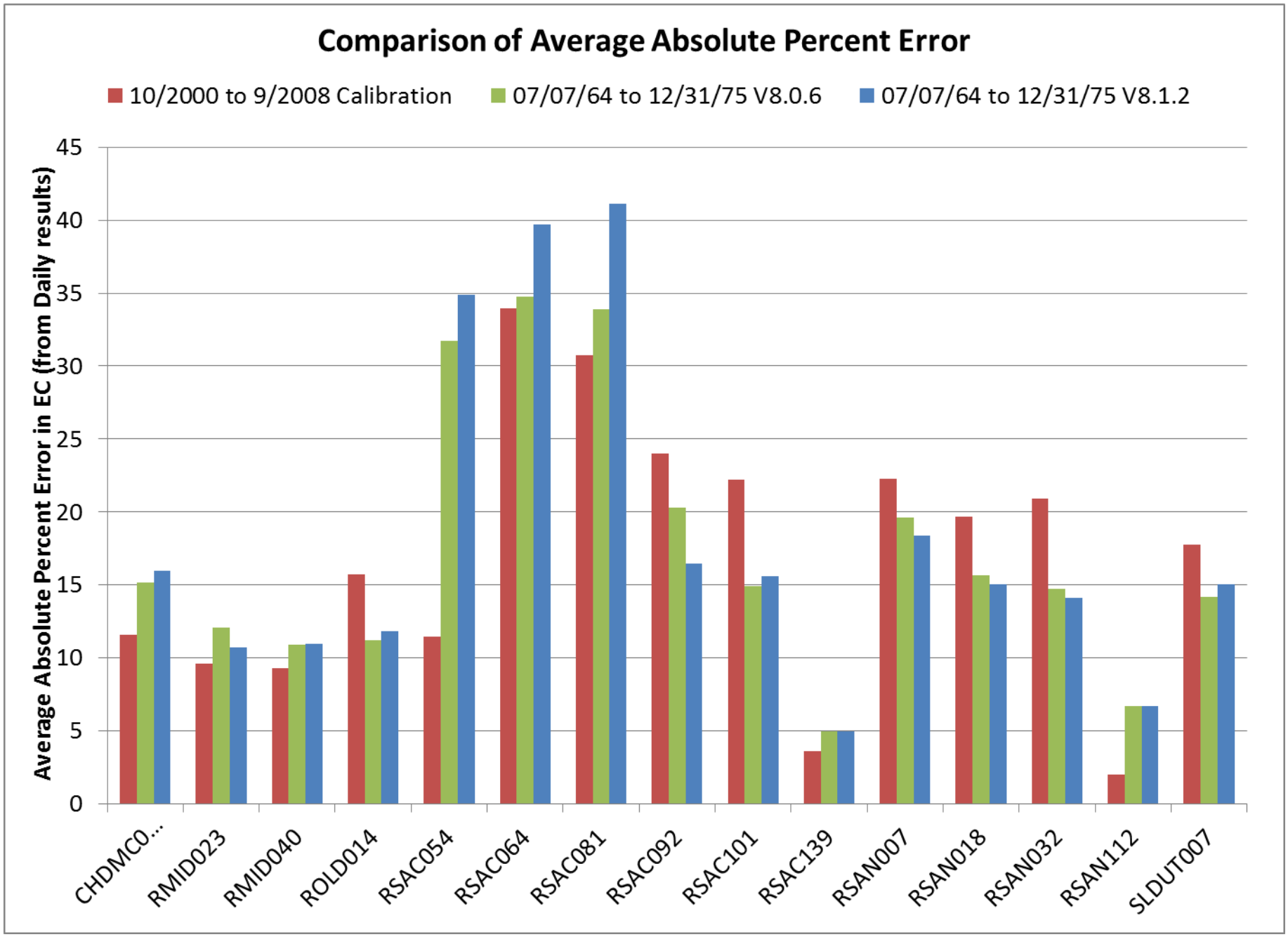

Predicted and Measured Stage at RSAN058 (Jan 1988)
RSAN058
DSM2 Historical V8.0.6
DSM2 Historical V8.1.2
Stage(ft, NAVD)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1/2/88
1/3/88
1/4/88
1/5/88
1/6/88
1/7/88
1/8/88
1/9/88

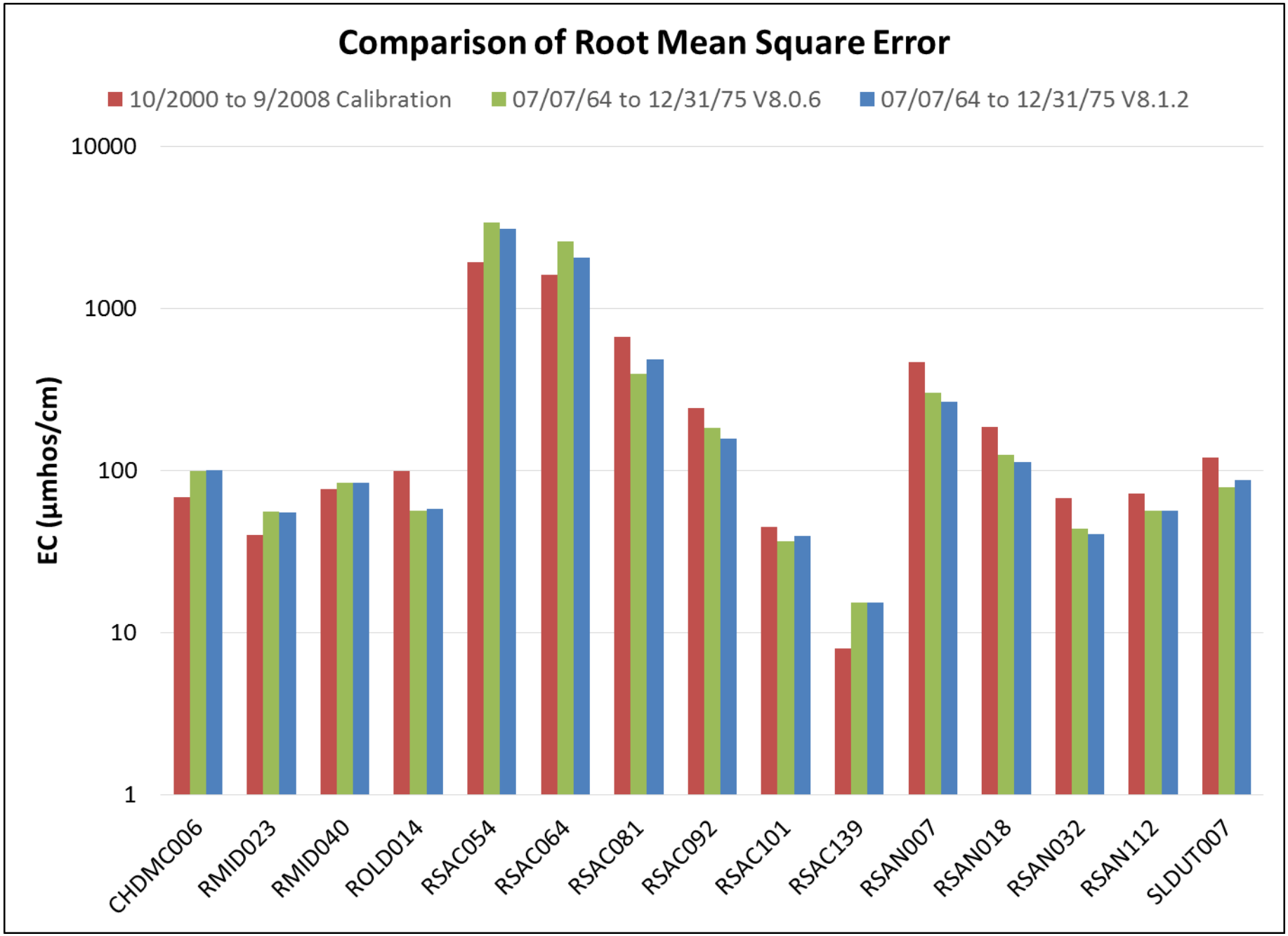

Predicted and Measured Stage at RSAN058 (Oct 1988)
RSAN058
DSM2 Historical V8.0.6
DSM2 Historical V8.1.2
Stage(ft, NAVD)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
10/2/88
10/3/88
10/4/88
10/5/88
10/6/88
10/7/88
10/8/88
10/9/88
10/10/88
10/11/88

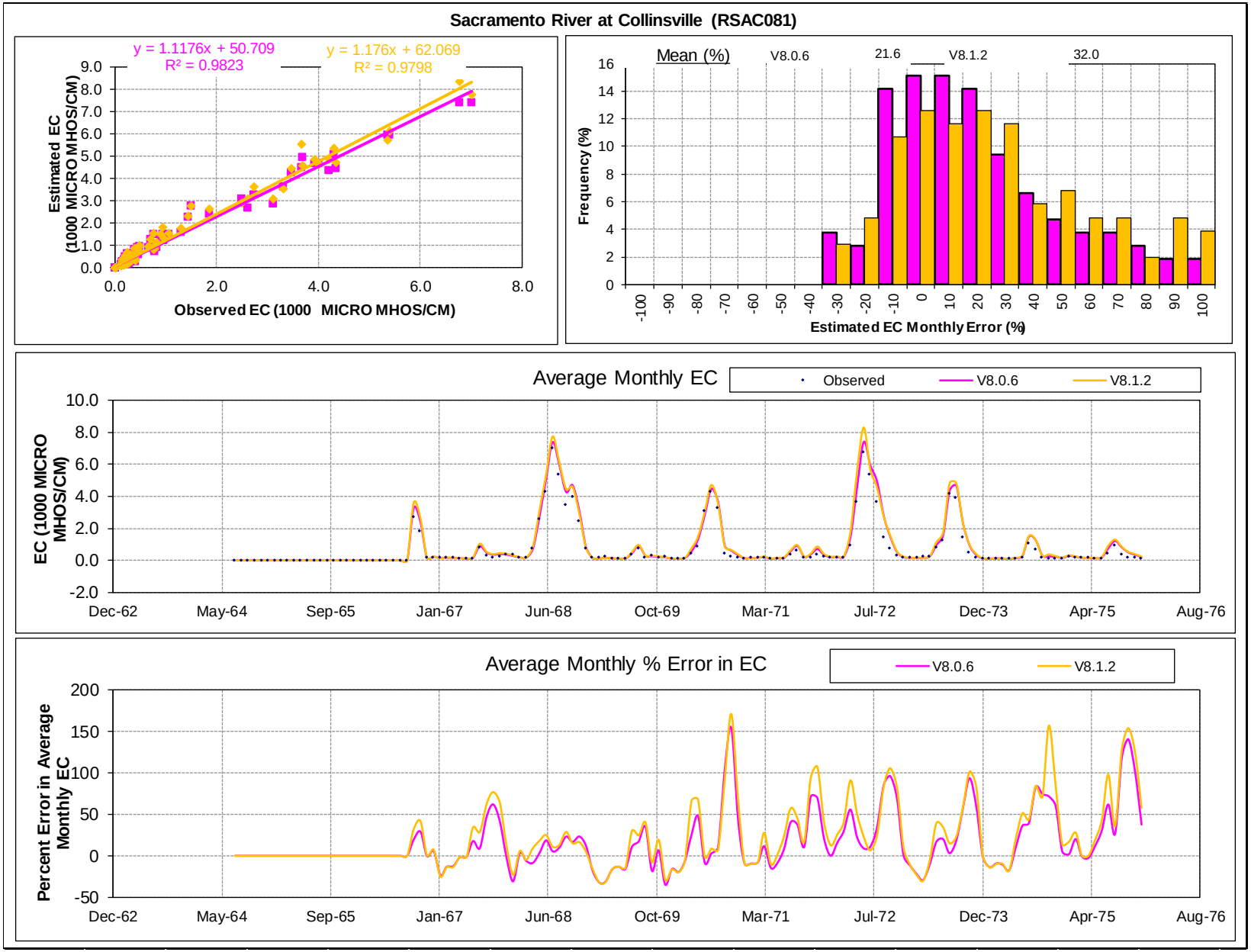
Limited EC Verification

- Focused on EC predictions between 1964 and 1975
- Compared errors in predicted EC with the values from 2009 recalibration
- EC results at 15 locations :

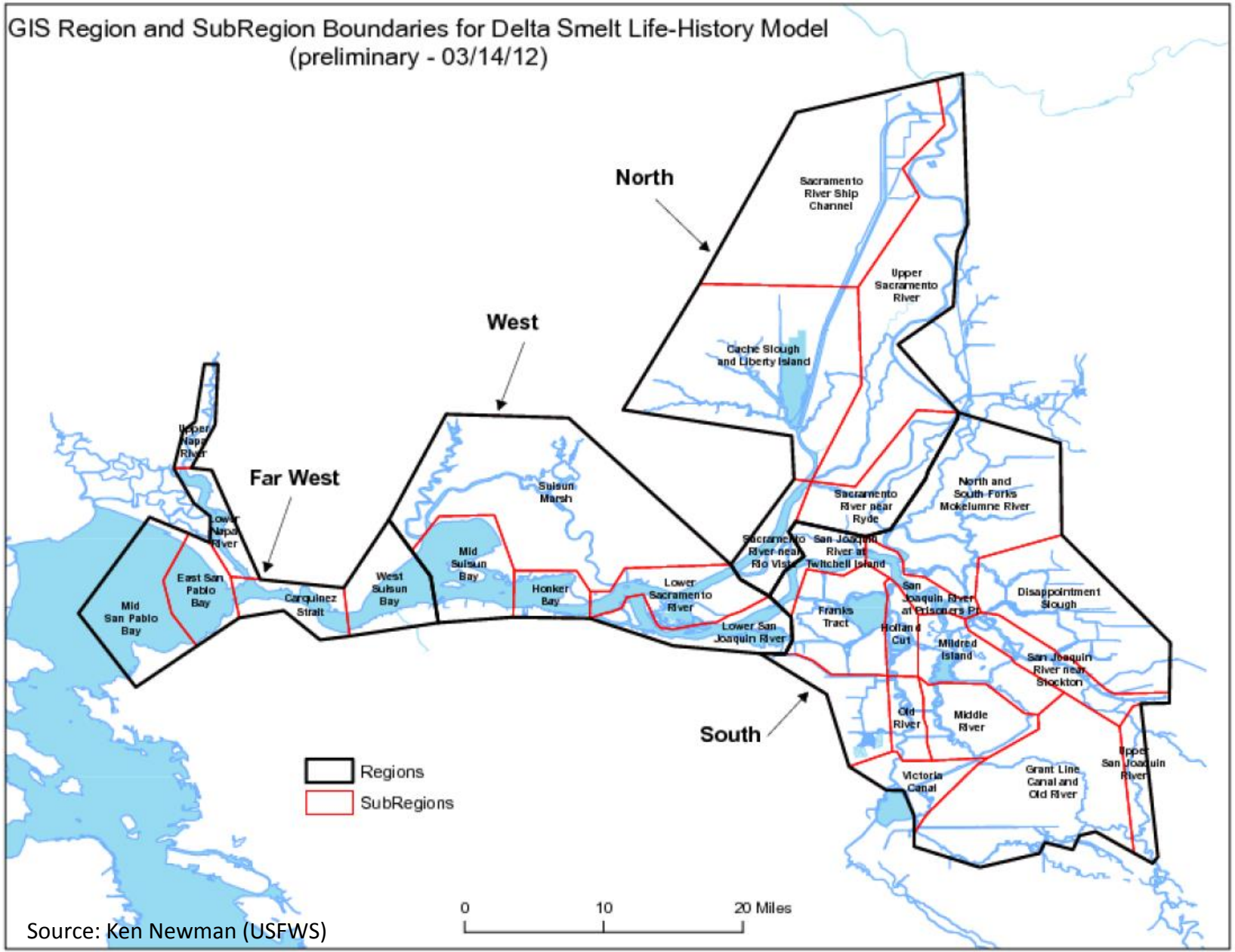
  - Delta Mendota Canal at Tracy Pumping Plant (CHDMC006)
  - Middle River at Borden Highway (RMID023)
  - Middle River at Mowry Bridge (RMID040)
  - Middle River at Union (RMID041)
  - Old River at Holland Cut (ROLD014)
  - Sacramento River at Port Chicago (RSAC064)
  - Sacramento River at Collinsville (RSAC081)
  - Sacramento River at Emmaton (RSAC092)
  - Sacramento River at Rio Vista (RSAC101)
  - Sacramento River at Greens Landing (RSAC139)
  - San Joaquin River near Antioch (RSAN007)
  - San Joaquin River at Jersey Point (RSAN018)
  - San Joaquin River at San Andreas Landing (RSAN032)
  - San Joaquin River at San Andreas Landing (RSAN112)
  - Dutch Slough (SLDUT007)


Comparison of Average Absolute Percent Error
10/2000 to 9/2008 Calibration
07/07/64 to 12/31/75 V8.0.6
07/07/64 to 12/31/75 V8.1.2
Average Absolute Percent Error in EC (from Daily results)
45
40
35
30
25
20
15
10
5
0
CHDMC0...
RMID023
RMID040
ROLD014
RSAC054
RSAC064
RSAC081
RSAC092
RSAC101
RSAC139
RSAN007
RSAN018
RSAN032
RSAN112
SLDUT007


Comparison of Root Mean Square Error
10/2000 to 9/2008 Calibration
07/07/64 to 12/31/75 V8.0.6
07/07/64 to 12/31/75 V8.1.2
EC (µmhos/cm)
10000
1000
100
10
1
CHDMC006
RMID023
RMID040
ROLD014
RSAC054
RSAC064
RSAC081
RSAC092
RSAC101
RSAC139
RSAN007
RSAN018
RSAN032
RSAN112
SLDUT007

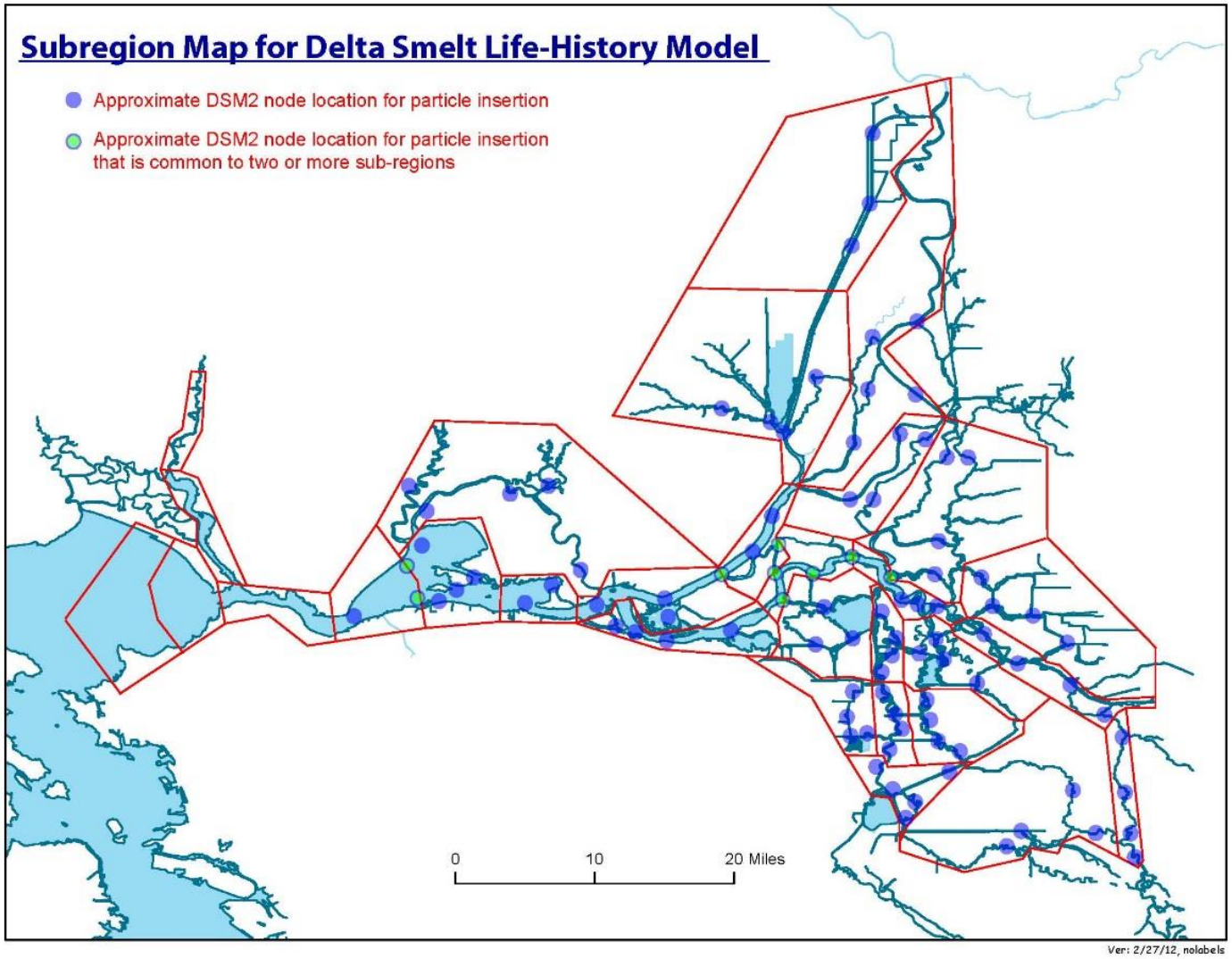

Sacramento River at Collinsville (RSAC081)
y = 1.1176x + 50.709
R² = 0.9823
y = 1.176x + 62.069
R² = 0.9798
Estimated EC (1000 MICRO MHOS/CM)
Observed EC (1000 MICRO MHOS/CM)
Mean (%)
V8.0.6
21.6
V8.1.2
32.0
Frequency (%)
Estimated EC Monthly Error (%)
Average Monthly EC
Observed
V8.0.6
V8.1.2
EC (1000 MICRO MHOS/CM)
Dec-62
May-64
Sep-65
Jan-67
Jun-68
Oct-69
Mar-71
Jul-72
Dec-73
Apr-75
Aug-76
Average Monthly % Error in EC
Percent Error in Average Monthly EC

Delta Smelt Life Cycle Model – Spatial Domain

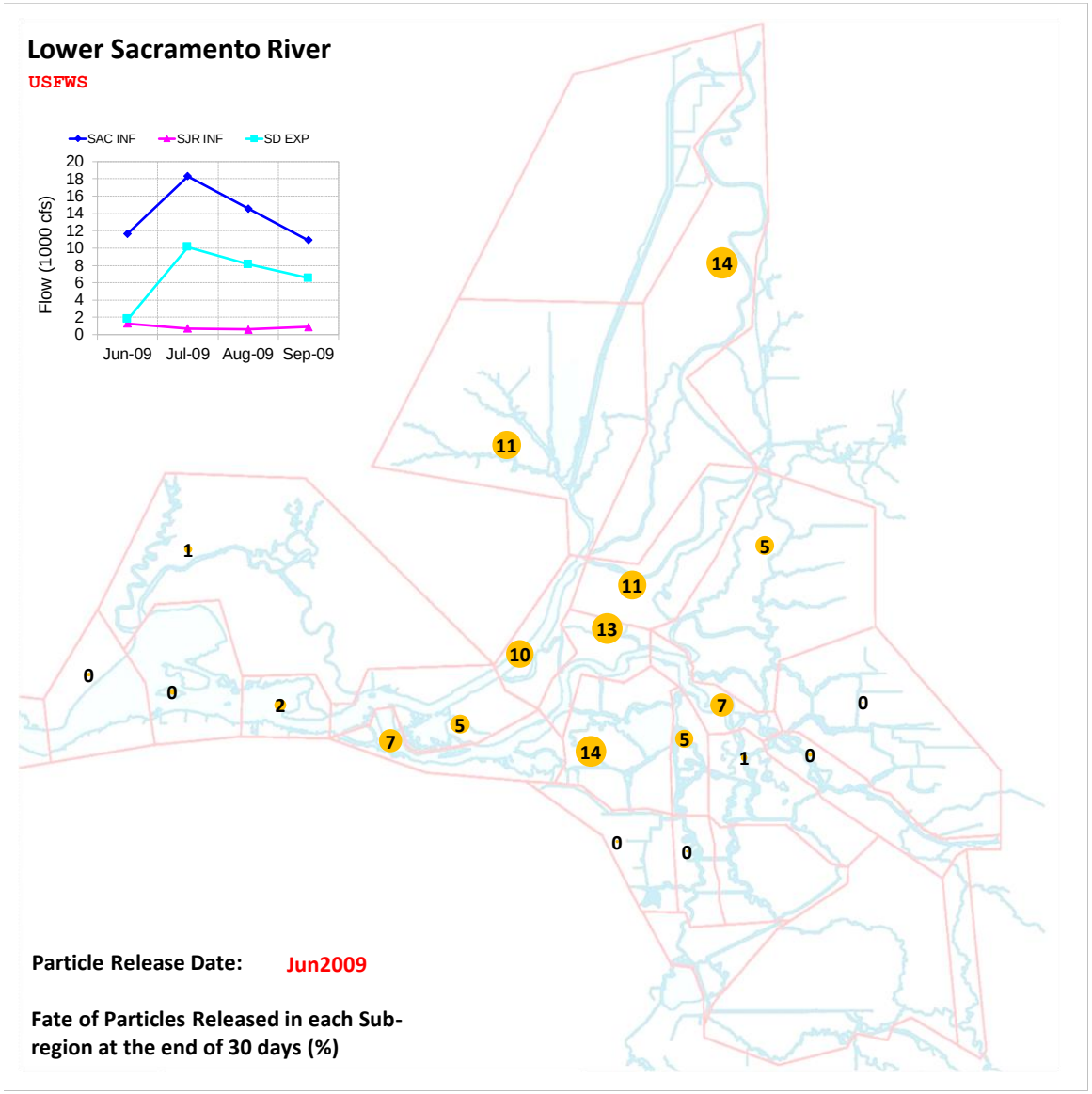


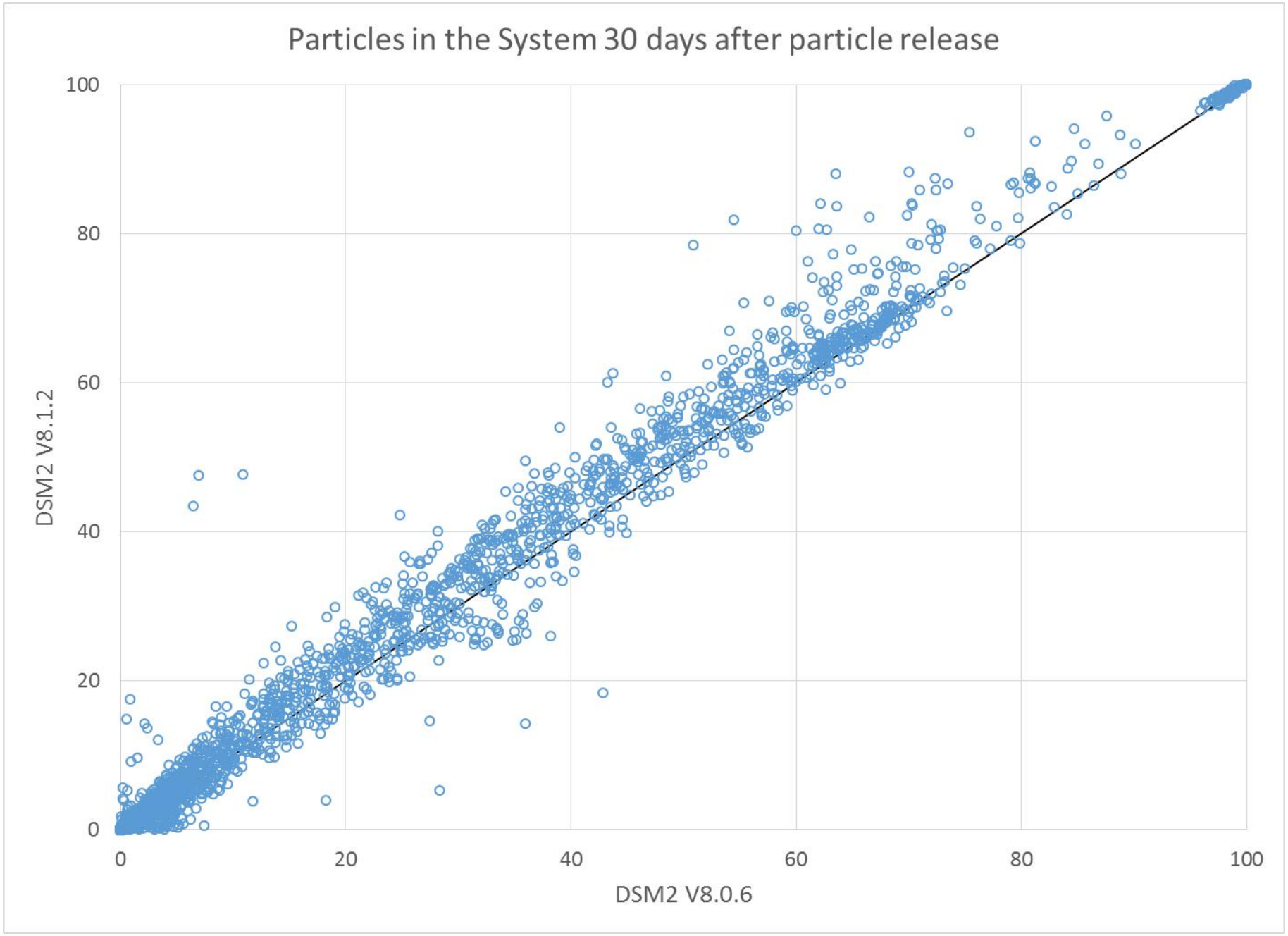
Source: Ken Newman (USFWS)

PTM Modeling



PTM Results Database Demonstration




Particles in the System 30 days after particle release
DSM2 V8.1.2
DSM2 V8.0.6
0
20
40
60
80
100

Summary and Limitations

- A representative DSM2 HYDRO and QUAL simulation was prepared for 1962 – 2015 period.
  - Quality of EC Boundary conditions are limited due to minimal data
- Future improvements should include
  - Appropriate location for pre-1971 Banks exports
  - Incorporate Island flooding events using reservoir-gate construct
  - A more complete verification of HYDRO and QUAL